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(21)Application number : 2001-224080 (71)Applicant : EQUOS RESEARCH CO LTD

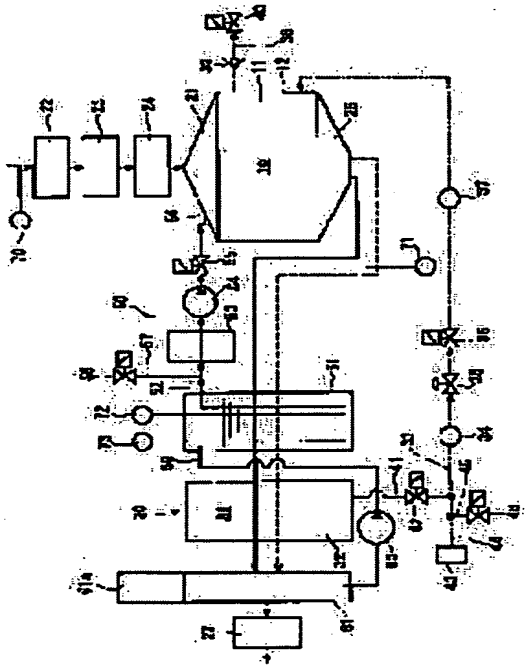
(22)Date of filing : 25.07.2001 (72)Inventor : HORIGUCHI MUNEHISA

(54) FUEL CELL SYSTEM AND ITS CONTROL METHOD

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a fuel cell system and its control method in which the system executes a stable electric power generation efficiency.

SOLUTION: The fuel cell system 1 has a fuel cell device 10 and hydrogen supply means 30 wherein the hydrogen supply means 30 has apparatuses 45, 46, 41 and 42 for removing foreign bodies that can enter from a hydrogen filling port 43.



LEGAL STATUS

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CLAIMS

[Claim(s)]
[Claim 1] The air pole to which the air in atmospheric air is supplied by air passage, and the hydrogen pole to which hydrogen gas is supplied by the hydrogen gas passageway, The fuel cell equipment which has the electrolyte layer of the solid-state macromolecule membrane type pinched by this air pole and this hydrogen pole, and produces power according to the electrochemical reaction of the oxygen in this air, and this hydrogen gas, The hydrogen supply pipe which connects the hydrogen storage equipment which stores hydrogen, and this hydrogen storage equipment and this fuel cell equipment as a hydrogen gas charging way, and supplies this hydrogen gas to this hydrogen gas passageway, In the fuel cell system equipped with a hydrogen supply means to have the hydrogen packed tube which connects this hydrogen storage equipment and hydrogen restoration opening which introduces hydrogen from the exterior said hydrogen supply means The fuel cell system characterized by having the foreign matter scavenging unit which eliminates the foreign matter which invades out of said hydrogen restoration opening.
[Claim 2] A foreign matter scavenging unit is a fuel cell system according to claim 1 characterized by having the exhaust pipe which opens a hydrogen packed tube outside, and the closing motion valve for foreign matter abatement which can open and close this exhaust pipe.
[Claim 3] A hydrogen packed tube is a fuel cell system according to claim 2 which is connected to hydrogen storage equipment through common tubing which is some hydrogen supply pipes, and is characterized by preparing the closing motion valve for bosses which can open and close passage in this common tubing.
[Claim 4] The closing motion valve for foreign matter abatement and the closing motion valve for bosses are a fuel cell system according to claim 3 characterized by being communalized.
[Claim 5] The air pole to which the air in atmospheric air is supplied by air passage, and the hydrogen pole to which hydrogen gas is supplied by the hydrogen gas passageway, The fuel cell equipment which has the electrolyte layer of the solid-state macromolecule membrane type pinched by this air pole and this hydrogen pole, and produces power according to the electrochemical reaction of the oxygen in this air, and this hydrogen gas, The hydrogen supply pipe which connects the hydrogen storage equipment which stores hydrogen, and this hydrogen storage equipment and this fuel cell equipment as a hydrogen gas charging way, and supplies this hydrogen gas to this hydrogen gas passageway, The hydrogen packed tube which connects this hydrogen storage equipment and hydrogen restoration opening which introduces hydrogen from the exterior, It is the fuel cell system equipped with a hydrogen supply means to have the foreign matter scavenging unit which eliminates the foreign matter which invades out of this hydrogen restoration opening. The control approach of the fuel cell system characterized by eliminating the foreign matter which invades into said hydrogen packed tube from the inside of this hydrogen restoration opening with said foreign matter scavenging unit in case the external source of hydrogen restoration is connected with said hydrogen restoration opening.
[Claim 6] A foreign matter scavenging unit has the exhaust pipe which opens a hydrogen packed tube outside, and the closing motion valve for foreign matter abatement which can open and close this exhaust pipe. The 1st step which this hydrogen packed tube is connected to hydrogen storage equipment through common tubing which is some hydrogen supply pipes, and the closing motion valve for bosses which can open and close passage is prepared in this common tubing, and closes

this closing motion valve for bosses, The 2nd step which waits for connection in hydrogen restoration opening and the source of hydrogen restoration where this closing motion valve for bosses is closed, The 3rd step which opens the fixed time amount this closing motion valve for foreign matter abatement when this hydrogen restoration opening and this source of hydrogen restoration are connected, The control approach of the fuel cell system according to claim 5 characterized by having the 4th step which closes this closing motion valve for foreign matter abatement after this fixed time amount progress, and the 5th step which opens this closing motion valve for bosses where this closing motion valve for foreign matter abatement is closed.
[Claim 7] The closing motion valve for foreign matter abatement and the closing motion valve for bosses are the control approach of the fuel cell system according to claim 6 characterized by being communalized.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to a fuel cell system and its control approach. This fuel cell system and its control approach use and are suitable for an electric vehicle, a hybrid car, etc.
[0002]
[Description of the Prior Art] Conventionally, the fuel cell system equipped with the direct injection nozzle as fuel cell equipment, the hydrogen supply means connected to this fuel cell equipment, and a feed water means connected to fuel cell equipment is known.
[0003] Fuel cell equipment has the electrolyte layer of a solid-state macromolecule membrane type which consists of ion exchange resin pinched by the air pole to which the air in atmospheric air is supplied by air passage, the hydrogen pole to which hydrogen gas is supplied by the hydrogen gas passageway, and an air pole and a hydrogen pole, and may have comes to produce power according to the electrochemical reaction of the oxygen in air, and hydrogen gas. A hydrogen supply means connects the hydrogen storage equipment which stores hydrogen with a hydrogen storing metal alloy, and hydrogen storage equipment and fuel cell equipment as a hydrogen gas charging way, and has the hydrogen supply pipe which can supply hydrogen gas to a hydrogen pole side.
[0004] Moreover, the fuel cell system equips the direct injection nozzle with the feed pipe as a supply channel which supplies water from the direct injection nozzle which supplies water to the air pole side of fuel cell equipment, the water tank which stores water, and the water tank.
[0005] While the air in atmospheric air is supplied to the air passage of fuel cell equipment in this fuel cell system, in a hydrogen pole side, the reaction of H2 ->2H++2e- is produced by supplying the hydrogen gas supplied to the hydrogen gas passageway of fuel cell equipment from a hydrogen supply means. H+ produced here moves an electrolyte layer in the form of H3O+, and produces the reaction of O(1/2)2+2H++2e-->H2O in an air pole side. In this way, in between a hydrogen pole and air poles, the electromotive force by the electrochemical reaction of H2+(1/2) O2 ->H2O will be acquired. Moreover, this will produce generation water in an air pole side.
[0006] And if the quantity to be stored of the hydrogen in hydrogen storage equipment decreases, it will drop in at a hydrogen stand with the source of hydrogen restoration, and the source of hydrogen restoration will be connected with hydrogen restoration opening with which it may fill up with hydrogen from the exterior. In this way, newly being filled up with hydrogen in hydrogen storage equipment is made through the hydrogen packed tube which connects hydrogen storage equipment and hydrogen restoration opening.
[0007]
[Problem(s) to be Solved by the Invention] However, in the above-mentioned conventional fuel cell system then, in case it is newly filled up with hydrogen, foreign matters, such as air which existed between the sources of hydrogen restoration, tend to invade in hydrogen restoration opening. In this way, when a foreign matter invades into a hydrogen supply means and the foreign matter exists in a fuel cell system, the fuel cell system has a possibility that it may become impossible to demonstrate the generation efficiency stabilized by the anomalous reaction.
[0008] If air is supplied to the hydrogen gas passageway of fuel cell equipment as a foreign matter, when the catalyst is supported by the electrolyte of a hydrogen pole as a matter which artificers grasp, the oxygen contained in air will form a local cell in a hydrogen pole, the catalyst currently

supported by the electrolyte of an air pole will be degraded, and it will become impossible that is, to demonstrate the stable generation efficiency. If air is supplied in hydrogen storage equipment as a foreign matter, when the hydrogen storage equipment uses the hydrogen storing metal alloy, a hydrogen storing metal alloy oxidizes, the hydrogen storage capacity of hydrogen storage equipment is spoiled, and it will become impossible moreover, to demonstrate the generation efficiency stabilized too.

[0009] This invention is made in view of the above-mentioned conventional actual condition, and makes it the technical problem which should be solved to offer the fuel cell system which can demonstrate the stable generation efficiency, and its control approach.

[0010]

[Means for Solving the Problem] The air pole to which, as for the fuel cell system of this invention, the air in atmospheric air is supplied by air passage, The fuel cell equipment which has the electrolyte layer of the solid-state macromolecule membrane type by which hydrogen gas was pinched by the hydrogen pole supplied by the hydrogen gas passageway, and this air pole and this hydrogen pole, and produces power according to the electrochemical reaction of the oxygen in this air, and this hydrogen gas, The hydrogen supply pipe which connects the hydrogen storage equipment which stores hydrogen, and this hydrogen storage equipment and this fuel cell equipment as a hydrogen gas charging way, and supplies this hydrogen gas to this hydrogen gas passageway, In the fuel cell system equipped with a hydrogen supply means to have the hydrogen packed tube which connects this hydrogen storage equipment and hydrogen restoration opening which introduces hydrogen from the exterior, said hydrogen supply means is characterized by having the foreign matter scavenging unit which eliminates the foreign matter which invades out of said hydrogen restoration opening.

[0011] Moreover, the control approach of the fuel cell system of this invention is the fuel cell system equipped with an above-mentioned hydrogen supply means have the above-mentioned fuel cell equipment and the foreign matter scavenging unit which eliminates the foreign matter which invades out of hydrogen restoration opening, and in case it connects the external source of hydrogen restoration with hydrogen restoration opening, it is characterized by to eliminate the foreign matter which invades into a hydrogen packed tube from the inside of hydrogen restoration opening with a foreign matter scavenging unit.

[0012] In case the external source of hydrogen restoration is connected with hydrogen restoration opening and hydrogen is newly filled up with the fuel cell system and approach of this invention, a foreign matter scavenging unit eliminates foreign matters, such as air which exists between the sources of hydrogen restoration and may invade out of hydrogen restoration opening. For this reason, a fuel cell system does not produce an anomalous reaction, but can demonstrate the stable generation efficiency.

[0013] That is, when a foreign matter is air, even if the catalyst is supported by the electrolyte of a hydrogen pole, the catalyst which a local cell is not formed in a hydrogen pole of the oxygen contained in air, and is supported by the electrolyte of an air pole does not deteriorate, but the stable generation efficiency can be demonstrated. Moreover, when a foreign matter is air, even if hydrogen storage equipment uses the hydrogen storing metal alloy, the hydrogen storing metal alloy maintains high hydrogen storage capacity, without oxidizing, and can demonstrate the generation efficiency stabilized too.

[0014] Therefore, according to this fuel cell system and approach, the stable generation efficiency can be demonstrated.

[0015] It can have the closing motion valve for foreign matter abatement which can open and close the exhaust pipe which opens a hydrogen packed tube outside, and this exhaust pipe as a concrete foreign matter scavenging unit of a hydrogen supply means. A hydrogen packed tube may be connected to hydrogen storage equipment apart from a hydrogen supply pipe. In this case, an exhaust pipe and the closing motion valve for foreign matter abatement may be connected to a hydrogen packed tube.

[0016] It is desirable that a hydrogen packed tube is connected to hydrogen storage equipment through common tubing which is some hydrogen supply pipes, and the closing motion valve for bosses which can open and close passage is prepared in common tubing. If the hydrogen packed tube

is connected to hydrogen storage equipment by common tubing, piping is simplified and there is effectiveness of cheap-izing of the manufacturing cost of a fuel cell system. Moreover, if the closing motion valve for bosses is prepared in common tubing, while being able to prevent certainly that a foreign matter invades into hydrogen storage equipment by closing the closing motion valve for bosses, it can prevent that hydrogen leaks at the time of exchange of hydrogen storage equipment.
[0017] Moreover, a foreign matter scavenging unit has an exhaust pipe and a closing motion valve for foreign matter abatement as the control approach of the fuel cell system of this invention. The 1st step which closes the closing motion valve for bosses when a hydrogen packed tube is connected to hydrogen storage equipment through common tubing and the closing motion valve for bosses is prepared in common tubing, The 2nd step which waits for connection in hydrogen restoration opening and the source of hydrogen restoration where the closing motion valve for bosses is closed, When hydrogen restoration opening and the source of hydrogen restoration are connected, it is desirable to have the 3rd step which opens the closing motion valve for fixed time amount foreign matter abatement, the 4th step which closes the closing motion valve for foreign matter abatement after fixed time amount progress, and the 5th step which opens the closing motion valve for bosses where the closing motion valve for foreign matter abatement is closed. In case it is newly filled up with hydrogen, a foreign matter scavenging unit can eliminate foreign matters, such as air, certainly by the approach of starting.
[0018] Furthermore, when a hydrogen packed tube is connected to hydrogen storage equipment through common tubing and the closing motion valve for bosses is prepared in common tubing, the closing motion valve for foreign matter abatement and the closing motion valve for bosses may be communalized. In this case, a cross valve can be used. If like this, components mark are reduced and there is effectiveness of cheap-izing of the manufacturing cost of a fuel cell system.
[0019] When the car carries the fuel cell system, the car needs to supply the hydrogen which serves as a fuel frequently. For this reason, the fuel cell system and its control approach of this invention are effective especially when it applies to a car.
[0020]
[Embodiment of the Invention] Hereafter, the operation gestalt which materialized this invention is explained, referring to a drawing.
[0021] As shown in drawing 1 , it connects with DC to DC converter 2 in an electric vehicle, and DC to DC converter 2 is connected with an inverter 4 through diode 3, and the fuel cell system 1 of an operation gestalt is connected with the motor 5 by which an inverter 4 drives the electric vehicle. Moreover, between diode 3 and an inverter 4 and between DC to DC converter 2 and the inverter 4, the dc-battery 6 as a rechargeable battery is connected. And these fuel cell system 1, DC to DC converter 2, the inverter 4, and the dc-battery 6 are electrically connected to the control section 7 equipped with CPU, ROM, RAM, and input/output port.
[0022] The fuel cell system 1 equips the direct injection nozzle 56 with the feed pipe 52 as a supply channel which supplies water from the direct injection nozzle 56 as fuel cell equipment 10, the hydrogen supply means 30 connected to this fuel cell equipment 10, and a feed water means connected to fuel cell equipment 10, the water tank 51 which stores water, and the water tank 51, as shown in drawing 2 .
[0023] The stack 12 which shows the part at drawing 3 in the housing 11 with which fuel cell equipment 10 constitutes an outline is contained. A stack 12 makes common separator 13a which adjoins each other in two or more cels 13, and is combined. Each cel 13 consists of the separators 13a and 13a which make a pair, air pole (cathode) 13b prepared between each separator 13a and 13a, electrolyte layer 13c of the solid-electrolyte membrane mold which consists of ion exchange resin, and 13d (anode) of hydrogen poles, as shown in drawing 4 . The catalyst of platinum etc. is supported by the electrolyte of air pole 13b, and the electrolyte of 13d of hydrogen poles. As shown in drawing 3 , two or more air passage 13e or 13f of two or more hydrogen gas passagewaies prolonged horizontally prolonged up and down is formed in separator 13a located in the ends of a stack 12, and each air passage 13e and 13f of each hydrogen passage are formed in other separator 13a.
[0024] As shown in drawing 2 , the upper bed of all air passage 13e and the charging manifold 21 open for free passage are being fixed above the housing 11 of fuel cell equipment 10, and the air

filter 22, the charging fan 23, and the heater 24 are connected to the upstream of the charging manifold 21 sequentially from the upstream. Moreover, under the housing 11 of fuel cell equipment 10, the soffit of all air passage 13e and the exhaust manifold 25 open for free passage are being fixed.

[0025] Moreover, in the soffit of an exhaust manifold 25, sequential advice of the emission gas discharged from fuel cell equipment 10 is carried out at the hydrogen storage equipment 31 and the condenser 61 of a water tank 51 and the hydrogen supply means 30.

[0026] The feed pipe 52 which makes the interior a supply channel is connected to the water tank 51, a feed pipe 52 is connected to two or more direct injection nozzles 56 through a water filter 53, a feed pump 54, and the closing motion valve 55, and each direct injection nozzle 56 is connected to the charging manifold 21. Moreover, between the feed pipe 52 and the water filter 53, the atmospheric-air open valve 58 is connected through the atmospheric-air disconnection tubing 57. The atmospheric-air disconnection tubing 57, a water tank 51, a feed pipe 52, the water filter 53, the feed pump 54, the closing motion valve 55, and the direct injection nozzle 56 are caudad located from the atmospheric-air open valve 58. The atmospheric-air open valve 58, the atmospheric-air disconnection tubing 57, the water filter 53, the feed pump 54, the closing motion valve 55, and the direct injection nozzle 56 are located more in a detail from the upper part one by one.

[0027] On the other hand, the return water tubing 59 which makes the interior a return water way is connected to the water tank 51, and the return water tubing 59 is connected to the pars basilaris ossis occipitalis of a condenser 61 through the return condensate pump 60. The condenser 61 has cooling-fan 61a, cools emission gas by this cooling-fan 61a, and divides emission gas into air and water. In this way, the water stored by the pars basilaris ossis occipitalis of a condenser 61 is pumped up by the return condensate pump 60, and flows back to a water tank 51 through the return water tubing 59. Moreover, the air filter 27 is formed in the downstream rather than the condenser 61, and the air separated from emission gas by the condenser 61 is emitted to atmospheric air through an air filter 27. As for an air filter 27, the impurity from the outside prevents invading in a fuel cell system. The return water tubing 59, a return condensate pump 60, and a condenser 61 are auxiliary machinery 50.

[0028] Moreover, between a water tank 51 and a condenser 61, the hydrogen storage equipment 31 of the hydrogen supply means 30 is located. It fills up with a hydrogen storing metal alloy in the housing 32 with which hydrogen storage equipment 31 constitutes an outline. Moreover, a high-pressure hydrogen tank can also be used for hydrogen storage equipment 31. The common tubing 41 which makes the interior passage is connected to the housing 32 of hydrogen storage equipment 31, and the closing motion valve 42 for bosses which can open and close passage is formed in the common tubing 41.

[0029] Down-stream, the hydrogen supply pipes 33 also including the interior of the common tubing 41 which make the interior a hydrogen gas charging way are connected from the closing motion valve 42 for bosses of the common tubing 41. It connects with the side of the housing 11 of fuel cell equipment 10 through the primary-pressure-of-reducing-valve sensor 34, a pressure regulating valve 35, the closing motion valve 36, and the secondary-pressure-of-reducing-valve sensor 37, and the hydrogen supply pipe 33 is open for free passage to the entry side of 13f of all hydrogen gas passagewaies of the stack 12 shown in drawing 3 .

[0030] Moreover, as shown in drawing 2 , down-stream, the hydrogen packed tube 44 connected to the hydrogen restoration opening 43 is connected from the closing motion valve 42 for bosses of the common tubing 41. An exhaust pipe 45 is connected to the hydrogen packed tube 44, and the closing motion valve 46 for foreign matter abatement is formed in the exhaust pipe 45. These exhaust pipes 45, the closing motion valve 46 for foreign matter abatement, the common tubing 41, and the closing motion valve 42 for bosses are foreign matter scavenging units.

[0031] Furthermore, the hydrogen exhaust pipe 38 open for free passage is connected with the outlet side of 13f of all hydrogen gas passagewaies of fuel cell equipment 10, and the closing motion valve 40 is formed in the side of the housing 11 of fuel cell equipment 10 through the check valve 39 at the hydrogen exhaust pipe 38. A foreign matter scavenging unit is the hydrogen supply means 30 at these hydrogen storage equipment 31, the hydrogen supply pipe 33, a pressure regulating valve 35, the closing motion valve 36, the hydrogen exhaust pipe 38, a check valve 39, and closing motion

valve 40 list.
[0032] Moreover, the outside-air-temperature sensor 70 for detecting outside air temperature is formed in the upstream of an air filter 22, and the blowdown temperature sensor 71 for detecting the outlet temperature of emission gas is formed in the location near an exhaust manifold 25. Moreover, in the water tank 51, the sensor 73 is formed at least for the coolant temperature sensor 72 for detecting the temperature of the water currently stored in the interior, and the water for detecting the water level of the water. It is inputted into a control section 7 as the detecting signal of a sensor 73 shows at least these outside-air-temperature sensor 70, the blowdown temperature sensor 71, a coolant temperature sensor 72, and water to drawing 1 .
[0033] The above-mentioned closing motion valve 55, the atmospheric-air open valve 58, the closing motion valve 36, the closing motion valve 40, the closing motion valve 42 for bosses, and the closing motion valve 46 for foreign matter abatement consist of solenoid valves. Moreover, the above-mentioned feed pump 54, a return condensate pump 60, the primary-pressure-of-reducing-valve sensor 34, the secondary-pressure-of-reducing-valve sensor 37, the charging fan 23, a heater 24, and cooling-fan 61a are also electrically connected to the control section 7 at these closing motion valve 55, the atmospheric-air open valve 58, the closing motion valve 36, the closing motion valve 40, the closing motion valve 42 for bosses, and the closing motion valve 46 list for foreign matter abatement.
[0034] In the fuel cell system 1 constituted as mentioned above, the above-mentioned feed pump 54, a return condensate pump 60, the charging fan 23, and cooling-fan 61a drive by the command of a control section 7 in the closing motion valve 55, the atmospheric-air open valve 58, the closing motion valve 36, the closing motion valve 40, the closing motion valve 42 for bosses, and the closing motion valve 46 list for foreign matter abatement. Especially, a heater 24 drives by the command of a control section 7 under the environment where freezing point lower and outside air temperature are low temperature.
[0035] Thereby, the air in atmospheric air is supplied to fuel cell equipment 10 through an air filter 22, the charging fan 23, a heater 24, and the charging manifold 21. In this way, air is supplied to all air passage 13e of a stack 12.
[0036] On the other hand, the hydrogen gas in hydrogen storage equipment 31 is supplied to fuel cell equipment 10 through the hydrogen supply pipe 33, a pressure regulating valve 35, and the closing motion valve 36. In this way, hydrogen gas is supplied to 13f of all hydrogen gas passagewaies of a stack 12.
[0037] Thereby, electrochemical reaction is produced between 13d of all hydrogen poles of a stack 12, and all air pole 13b, and electromotive force is acquired. in this way, the acquired electromotive force -- DC to DC converter 2 -- pressure up -- or it decompresses and is impressed by the dc-battery 6 and the inverter 4. A motor 5 drives by this and transit of an electric vehicle is attained.
[0038] And if the quantity to be stored of the hydrogen in hydrogen storage equipment 31 decreases, it will drop in at a hydrogen stand with the source of hydrogen restoration, and the source of hydrogen restoration will be connected with the hydrogen restoration opening 43. In the meantime, a control section 7 controls according to the flow chart shown in drawing 5 . First, in the 1st step S10, the closing motion valve 42 for bosses is closed. Then, in the 2nd step S11, where the closing motion valve 42 for bosses is closed, it waits for connection of the source of hydrogen restoration to the hydrogen restoration opening 43. And in the 3rd step S12, if the source of hydrogen restoration is connected with the hydrogen restoration opening 43, the closing motion valve 46 for fixed time amount foreign matter abatement will be opened. Then, in the 4th step S13, the closing motion valve 46 for foreign matter abatement is closed after fixed time amount progress. And in the 5th step S14, where the closing motion valve 46 for foreign matter abatement is closed, the closing motion valve 42 for bosses is opened.
[0039] In this way, newly being filled up with hydrogen in hydrogen storage equipment 31 is made through the hydrogen packed tube 44 which connects hydrogen storage equipment 31 and the hydrogen restoration opening 43. Under the present circumstances, a foreign matter scavenging unit can eliminate foreign matters, such as air, certainly. For this reason, this fuel cell system 1 does not produce an anomalous reaction, but can demonstrate the stable generation efficiency.
[0040] That is, in fuel cell equipment 10, even if the catalyst is supported by the electrolyte of 13d of

hydrogen poles, the catalyst which a local cell is not formed in 13d of hydrogen poles of the oxygen contained in air, and is supported by the electrolyte of air pole 13b does not deteriorate, but the stable generation efficiency can be demonstrated. Moreover, the hydrogen storing metal alloy of hydrogen storage equipment 31 maintains high hydrogen storage capacity, without oxidizing, and can demonstrate the generation efficiency stabilized too.

[0041] Therefore, according to this fuel cell system 1 and approach, the stable generation efficiency can be demonstrated.

[0042] Moreover, by this fuel cell system 1 and approach, since the hydrogen packed tube 43 is connected to hydrogen storage equipment 31 through the common tubing 41 which is some hydrogen supply pipes 33 and the closing motion valve 42 for bosses is formed in the common tubing 31, piping is simplified and there is effectiveness of cheap-izing of a manufacturing cost. Moreover, since the closing motion valve 42 for bosses is formed in the common tubing 41, while being able to prevent certainly that a foreign matter invades into hydrogen storage equipment 31 by closing the closing motion valve 42 for bosses, it can prevent that hydrogen leaks at the time of exchange of hydrogen storage equipment 31.

[0043] In addition, as shown in drawing 6 , the hydrogen packed tube 47 connected to hydrogen storage equipment 31 independently [the hydrogen supply pipe 33] can also be formed. In this case, it is desirable to form the closing motion valve 42 for bosses, an exhaust pipe 45, and the closing motion valve 46 for foreign matter abatement in the hydrogen packed tube 47.

[0044] Moreover, as shown in drawing 7 , when the hydrogen packed tube 44 is connected to hydrogen storage equipment 31 through the common tubing 41, the cross valve 48 which communalizes the closing motion valve for foreign matter abatement and the closing motion valve for bosses can also be formed between the common tubing 41, the hydrogen packed tube 44, and the hydrogen supply pipe 33. In this case, components mark are reduced and there is effectiveness of cheap-izing of the manufacturing cost of a fuel cell system.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the block block diagram of the electric vehicle concerning an operation gestalt.
[Drawing 2] It is fuel cell structure-of-a-system drawing concerning an operation gestalt.
[Drawing 3] a part of stack concerning an operation gestalt -- it is a perspective view.
[Drawing 4] It is the sectional view of the cel concerning an operation gestalt.
[Drawing 5] It is the flow chart of the control section concerning an operation gestalt.
[Drawing 6] It is the important section block diagram of the fuel cell system concerning a deformation gestalt.
[Drawing 7] It is the important section block diagram of the fuel cell system concerning a deformation gestalt.
[Description of Notations]
13e -- Air passage
13b -- Air pole
13f -- Hydrogen gas passageway
13d -- Hydrogen pole
13c -- Electrolyte layer
10 -- Fuel cell equipment
30 -- Hydrogen supply means
31 [-- A hydrogen packed tube, 45, 46, 41, 42 / -- Foreign matter scavenging unit (45 / -- Common tubing, 42 / -- Closing motion valve for bosses / -- an exhaust pipe 46 -- the closing motion valve for foreign matter abatement, 41)] -- Hydrogen storage equipment, 33 -- A hydrogen supply pipe, 43 -- Hydrogen restoration opening, 44
1 -- Fuel cell system
7 -- Control section

[Translation done.]

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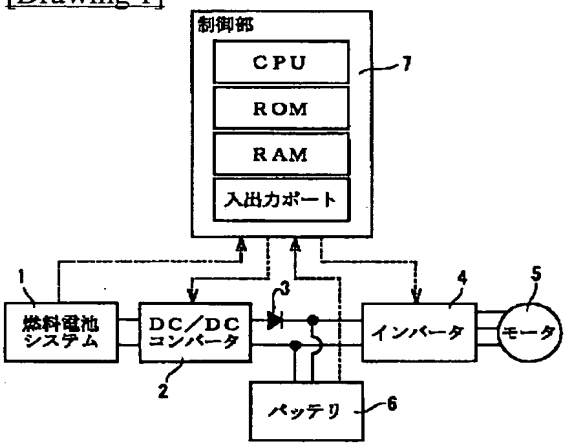
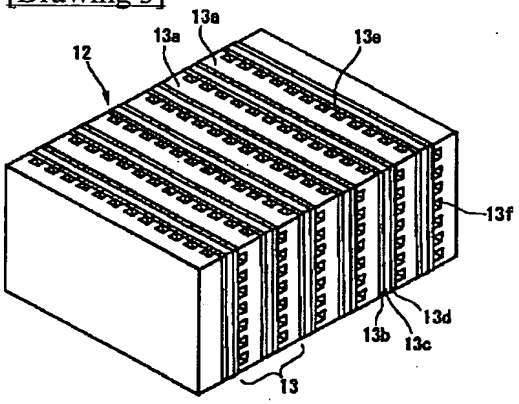
DRAWINGS

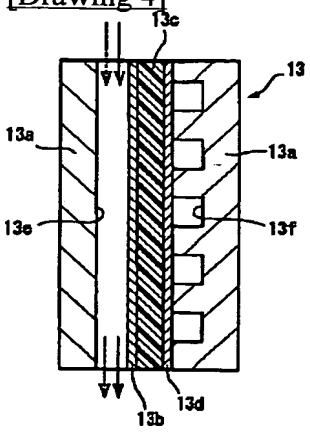
[Drawing 1]



[Drawing 3]



[Drawing 4]



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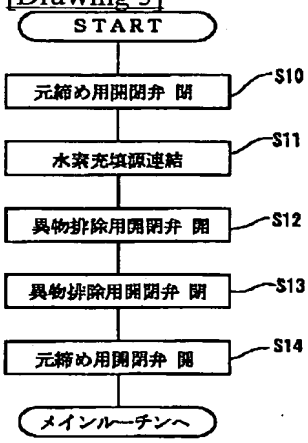

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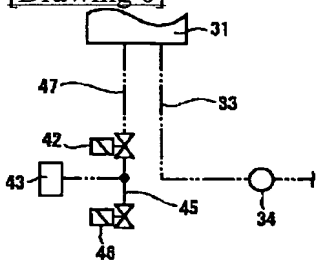
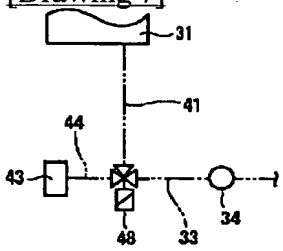
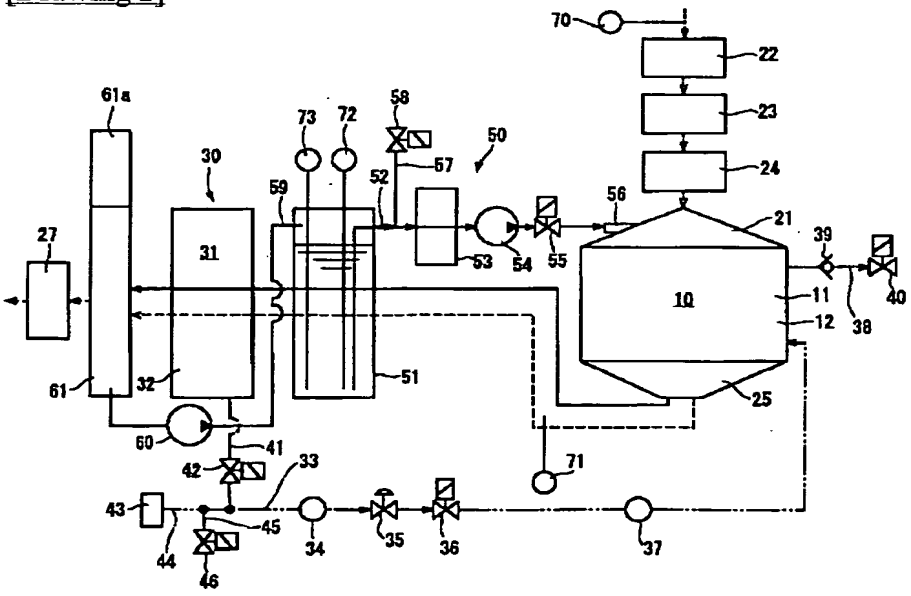


[Drawing 7]



[Drawing 2]



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			Ｊ	５Ｈ０２７
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(71)出願人　591261509
株式会社エクォス・リサーチ
東京都千代田区外神田２丁目19番12号
(72)発明者　堀口　宗久
東京都千代田区外神田２丁目19番12号　株式会社エクォス・リサーチ内
(74)代理人　100109069
弁理士　中村　敬

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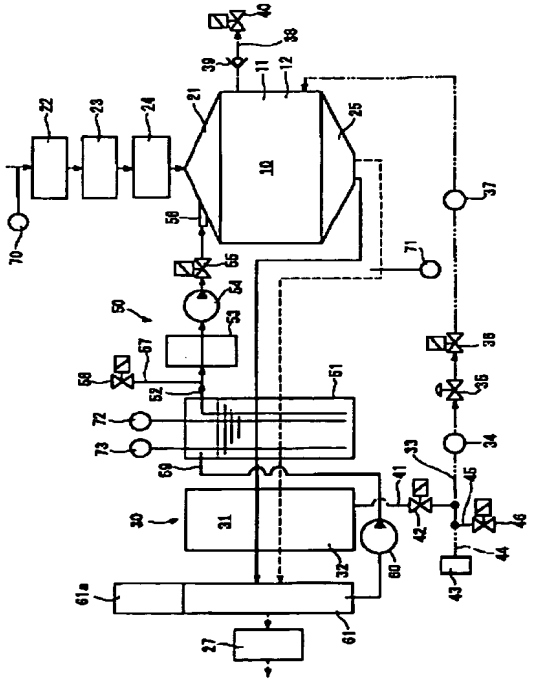
(54)【発明の名称】　燃料電池システム及びその制御方法

(57)【要約】
【課題】安定した発電効率を発揮可能な燃料電池システム及びその制御方法を提供する。
【解決手段】燃料電池装置１０と水素供給手段３０とを備えた燃料電池システム１において、水素供給手段３０は、水素充填口４３内から侵入し得る異物を排除可能な異物排除装置４５、４６、４１、４２を有する。



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【特許請求の範囲】

【請求項１】大気中の空気が空気流路により供給される空気極と、水素ガスが水素ガス流路により供給される水素極と、該空気極及び該水素極に挟持された固体高分子膜型の電解質層とを有し、該空気中の酸素と該水素ガスとの電気化学反応により電力を生じる燃料電池装置と、水素を貯蔵する水素貯蔵装置と、該水素貯蔵装置と該燃料電池装置とを水素ガス給気路として接続し、該水素ガス流路に該水素ガスを供給する水素供給管と、該水素貯蔵装置と外部から水素を導入する水素充填口とを接続する水素充填管とを有する水素供給手段と、

を備えた燃料電池システムにおいて、

前記水素供給手段は、前記水素充填口内から侵入する異物を排除する異物排除装置を有することを特徴とする燃料電池システム。

【請求項２】異物排除装置は、水素充填管を外部に開放する排出管と、該排出管を開閉可能な異物排除用開閉弁とをもつことを特徴とする請求項１記載の燃料電池システム。

【請求項３】水素充填管は水素供給管の一部である共通管を介して水素貯蔵装置に接続され、該共通管には流路を開閉可能な元締め用開閉弁が設けられていることを特徴とする請求項２記載の燃料電池システム。

【請求項４】異物排除用開閉弁と元締め用開閉弁とは共通化されていることを特徴とする請求項３記載の燃料電池システム。

【請求項５】大気中の空気が空気流路により供給される空気極と、水素ガスが水素ガス流路により供給される水素極と、該空気極及び該水素極に挟持された固体高分子膜型の電解質層とを有し、該空気中の酸素と該水素ガスとの電気化学反応により電力を生じる燃料電池装置と、水素を貯蔵する水素貯蔵装置と、該水素貯蔵装置と該燃料電池装置とを水素ガス給気路として接続し、該水素ガス流路に該水素ガスを供給する水素供給管と、該水素貯蔵装置と外部から水素を導入する水素充填口とを接続する水素充填管と、該水素充填口内から侵入する異物を排除する異物排除装置とを有する水素供給手段とを備えた燃料電池システムであって、

外部の水素充填源を前記水素充填口に連結する際、該水素充填口内から前記水素充填管に侵入する異物を前記異物排除装置により排除することを特徴とする燃料電池システムの制御方法。

【請求項６】異物排除装置は、水素充填管を外部に開放する排出管と、該排出管を開閉可能な異物排除用開閉弁とをもち、

該水素充填管は水素供給管の一部である共通管を介して水素貯蔵装置に接続され、該共通管には流路を開閉可能な元締め用開閉弁が設けられ、

該元締め用開閉弁を閉じる第１ステップと、

該元締め用開閉弁が閉じられた状態で水素充填口と水素充填源との連結を待つ第２ステップと、

該水素充填口と該水素充填源とが連結された場合、一定時間該異物排除用開閉弁を開く第３ステップと、

該一定時間経過後に該異物排除用開閉弁を閉じる第４ステップと、

該異物排除用開閉弁が閉じられた状態で該元締め用開閉弁を開ける第５ステップと、

を備えることを特徴とする請求項５記載の燃料電池システムの制御方法。

【請求項７】異物排除用開閉弁と元締め用開閉弁とは共通化されていることを特徴とする請求項６記載の燃料電池システムの制御方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は燃料電池システム及びその制御方法に関する。この燃料電池システム及びその制御方法は電気自動車、ハイブリッド車等に用いて好適である。

【０００２】

【従来の技術】従来、燃料電池装置と、この燃料電池装置に接続された水素供給手段と、燃料電池装置に接続された給水手段としての直噴ノズルとを備えた燃料電池システムが知られている。

【０００３】燃料電池装置は、大気中の空気が空気流路により供給される空気極と、水素ガスが水素ガス流路により供給される水素極と、空気極及び水素極に挟持されたイオン交換樹脂からなる固体高分子膜型の電解質層とを有しており、空気中の酸素と水素ガスとの電気化学反応により電力を生じ得るようになっている。水素供給手段は、水素吸蔵合金により水素を貯蔵する水素貯蔵装置と、水素貯蔵装置と燃料電池装置とを水素ガス給気路として接続し、水素極側に水素ガスを供給可能な水素供給管とを有している。

【０００４】また、燃料電池システムは、燃料電池装置の空気極側に水を供給する直噴ノズルと、水を貯溜する水タンクと、水タンクから直噴ノズルに水を供給する給水路としての給水管とを備えている。

【０００５】この燃料電池システムでは、燃料電池装置の空気流路に大気中の空気が供給される一方、燃料電池装置の水素ガス流路に水素供給手段から供給される水素ガスが供給されることにより、水素極側では、

$H_2 \rightarrow 2H^+ + 2e^-$

の反応を生じる。ここで生じたH^+がH_3O^+の形で電解質層を移動し、空気極側において、

（１／２）$O_2 + 2H^+ + 2e^- \rightarrow H_2O$

の反応を生じる。こうして、水素極と空気極との間において、

$H_2 + (1/2)O_2 \rightarrow H_2O$

の電気化学反応による起電力が得られることとなる。また、これにより空気極側では生成水を生じることとな

る。

【０００６】そして、水素貯蔵装置内の水素の貯蔵量が減少してくれば、水素充填源をもつ水素スタンドに立ち寄り、外部より水素が充填され得る水素充填口に水素充填源を連結する。こうして、水素貯蔵装置と水素充填口とを接続する水素充填管を介し、水素貯蔵装置内に新たに水素を充填することがなされる。

【０００７】

【発明が解決しようとする課題】しかし、上記従来の燃料電池システムでは、そうして新たに水素を充填する際、水素充填源との間に存在した空気等の異物が水素充填口内に侵入してしまいやすい。こうして水素供給手段に異物が侵入し、その異物が燃料電池システム内に存在していると、その燃料電池システムは異常反応により安定した発電効率を発揮できなくなるおそれがある。

【０００８】すなわち、発明者らが把握している事項として、空気が異物として燃料電池装置の水素ガス流路に供給されてしまうと、水素極の電解質に触媒が担持されている場合、空気に含まれる酸素が水素極内で局部的な電池を形成してしまい、空気極の電解質に担持されている触媒を劣化させてしまい、安定した発電効率を発揮できなくなってしまう。また、空気が異物として水素貯蔵装置内に供給されてしまうと、その水素貯蔵装置が水素吸蔵合金を用いている場合、水素吸蔵合金が酸化され、水素貯蔵装置の水素貯蔵能力が損なわれ、やはり安定した発電効率を発揮できなくなってしまう。

【０００９】本発明は、上記従来の実情に鑑みてなされたものであって、安定した発電効率を発揮可能な燃料電池システム及びその制御方法を提供することを解決すべき課題としている。

【００１０】

【課題を解決するための手段】本発明の燃料電池システムは、大気中の空気が空気流路により供給される空気極と、水素ガスが水素ガス流路により供給される水素極と、該空気極及び該水素極に挟持された固体高分子膜型の電解質層とを有し、該空気中の酸素と該水素ガスとの電気化学反応により電力を生じる燃料電池装置と、水素を貯蔵する水素貯蔵装置と、該水素貯蔵装置と該燃料電池装置とを水素ガス給気路として接続し、該水素ガス流路に該水素ガスを供給する水素供給管と、該水素貯蔵装置と外部から水素を導入する水素充填口とを接続する水素充填管とを有する水素供給手段と、を備えた燃料電池システムにおいて、前記水素供給手段は、前記水素充填口内から侵入する異物を排除する異物排除装置を有することを特徴とする。

【００１１】また、本発明の燃料電池システムの制御方法は、上記燃料電池装置と、水素充填口内から侵入する異物を排除する異物排除装置を有する上記水素供給手段とを備えた燃料電池システムであって、外部の水素充填源を水素充填口に連結する際、水素充填口内から水素充填管に侵入する異物を異物排除装置により排除することを特徴とする。

【００１２】本発明の燃料電池システム及び方法では、外部の水素充填源を水素充填口に連結し、新たに水素を充填する際、水素充填源との間に存在して水素充填口内から侵入し得る空気等の異物を異物排除装置が排除する。このため、燃料電池システムは、異常反応を生じず、安定した発電効率を発揮できる。

【００１３】すなわち、異物が空気である場合、水素極の電解質に触媒が担持されていても、空気に含まれる酸素によって水素極内で局部的な電池が形成されることはなく、空気極の電解質に担持されている触媒が劣化せず、安定した発電効率を発揮できる。また、異物が空気である場合、水素貯蔵装置が水素吸蔵合金を用いていても、その水素吸蔵合金は酸化されずに高い水素貯蔵能力を維持し、やはり安定した発電効率を発揮できる。

【００１４】したがって、この燃料電池システム及び方法によれば、安定した発電効率を発揮可能である。

【００１５】水素供給手段の具体的な異物排除装置としては、水素充填管を外部に開放する排出管と、この排出管を開閉可能な異物排除用開閉弁とをもつことができる。水素充填管は水素供給管とは別に水素貯蔵装置に接続され得る。この場合、水素充填管に排出管及び異物排除用開閉弁が接続され得る。

【００１６】水素充填管は水素供給管の一部である共通管を介して水素貯蔵装置に接続され、共通管には流路を開閉可能な元締め用開閉弁が設けられていることが好ましい。水素充填管が共通管により水素貯蔵装置に接続されておれば、配管が簡素化され、燃料電池システムの製造コストの低廉化の効果がある。また、共通管に元締め用開閉弁が設けられておれば、元締め用開閉弁を閉じることにより、異物が水素貯蔵装置に侵入することを確実に防止できるとともに、水素貯蔵装置の交換時に水素が漏れることを防止できる。

【００１７】また、本発明の燃料電池システムの制御方法として、異物排除装置が排出管と異物排除用開閉弁とをもち、水素充填管が共通管を介して水素貯蔵装置に接続され、共通管に元締め用開閉弁が設けられている場合、元締め用開閉弁を閉じる第１ステップと、元締め用開閉弁が閉じられた状態で水素充填口と水素充填源との連結を待つ第２ステップと、水素充填口と水素充填源とが連結された場合、一定時間異物排除用開閉弁を開く第３ステップと、一定時間経過後に異物排除用開閉弁を閉じる第４ステップと、異物排除用開閉弁が閉じられた状態で元締め用開閉弁を開ける第５ステップと、を備えることが好ましい。新たに水素を充填する際、かかる方法により、空気等の異物を異物排除装置が確実に排除することができる。

【００１８】さらに、水素充填管が共通管を介して水素貯蔵装置に接続され、共通管に元締め用開閉弁が設けら

れている場合、異物排除用開閉弁と元締め用開閉弁とは共通化され得る。この場合、三方弁を用いることができる。こうであれば、部品点数が削減され、燃料電池システムの製造コストの低廉化の効果がある。

【００１９】車両が燃料電池システムを搭載している場合、その車両は頻繁に燃料となる水素の補給を行なう必要がある。このため、本発明の燃料電池システム及びその制御方法は車両に適用した場合に特に有効である。

【００２０】

【発明の実施の形態】以下、本発明を具体化した実施形態を図面を参照しつつ説明する。

【００２１】図１に示すように、実施形態の燃料電池システム１は、電気自動車において、ＤＣ／ＤＣコンバータ２と接続され、ＤＣ／ＤＣコンバータ２はダイオード３を介してインバータ４と接続され、インバータ４がその電気自動車を駆動するモータ５と接続されている。また、ダイオード３とインバータ４との間及びＤＣ／ＤＣコンバータ２とインバータ４との間には二次電池としてのバッテリ６が接続されている。そして、これら燃料電池システム１、ＤＣ／ＤＣコンバータ２、インバータ４及びバッテリ６は、ＣＰＵ、ＲＯＭ、ＲＡＭ及び入出力ポートを備えた制御部７に電気的に接続されている。

【００２２】燃料電池システム１は、図２に示すように、燃料電池装置１０と、この燃料電池装置１０に接続された水素供給手段３０と、燃料電池装置１０に接続された給水手段としての直噴ノズル５６と、水を貯溜する水タンク５１と、水タンク５１から直噴ノズル５６に水を供給する給水路としての給水管５２とを備えている。

【００２３】燃料電池装置１０は、外郭を構成するハウジング１１内に図３にその一部を示すスタック１２が収納されたものである。スタック１２は複数個のセル１３を隣り合うセパレータ１３ａを共通させて組み合わせたものである。各セル１３は、図４に示すように、対をなすセパレータ１３ａ、１３ａと、各セパレータ１３ａ、１３ａ間に設けられた空気極（カソード）１３ｂと、イオン交換樹脂からなる固体電解質膜型の電解質層１３ｃと、水素極（アノード）１３ｄとで構成されている。空気極１３ｂの電解質及び水素極１３ｄの電解質には白金等の触媒が担持されている。図３に示すように、スタック１２の両端に位置するセパレータ１３ａには、上下に延びる複数本の空気流路１３ｅ又は水平に延びる複数本の水素ガス流路１３ｆが形成され、他のセパレータ１３ａには各空気流路１３ｅ及び各水素流路１３ｆが形成されている。

【００２４】燃料電池装置１０のハウジング１１の上方には、図２に示すように、全空気流路１３ｅの上端と連通する給気マニホールド２１が固定されており、給気マニホールド２１の上流側には、上流側から順にエアフィルタ２２、給気ファン２３及びヒータ２４が接続されている。また、燃料電池装置１０のハウジング１１の下方には全空気流路１３ｅの下端と連通する排気マニホールド２５が固定されている。

【００２５】また、排気マニホールド２５の下端では、燃料電池装置１０より排出される排出ガスが水タンク５１、水素供給手段３０の水素貯蔵装置３１及び凝縮器６１に順次案内されるようになっている。

【００２６】水タンク５１には内部を給水路とする給水管５２が接続されており、給水管５２は水フィルタ５３、給水ポンプ５４及び開閉弁５５を介して複数個の直噴ノズル５６に接続され、各直噴ノズル５６は給気マニホールド２１に接続されている。また、給水管５２と水フィルタ５３との間には大気開放管５７を介して大気開放弁５８が接続されている。大気開放弁５８より下方に大気開放管５７、水タンク５１、給水管５２、水フィルタ５３、給水ポンプ５４、開閉弁５５及び直噴ノズル５６が位置している。より詳細には、大気開放弁５８、大気開放管５７、水フィルタ５３、給水ポンプ５４、開閉弁５５、直噴ノズル５６が順次上方より位置している。

【００２７】他方、水タンク５１には内部を還水路とする還水管５９が接続されており、還水管５９は、還水ポンプ６０を介して凝縮器６１の底部に接続されている。凝縮器６１は、冷却ファン６１ａを有しており、この冷却ファン６１ａにより排出ガスの冷却を行い、排出ガスを空気と水とに分離するようになっている。こうして凝縮器６１の底部に貯溜された水が還水ポンプ６０により汲み上げられ、還水管５９を経て水タンク５１に還流されるようになっている。また、凝縮器６１よりも下流側にはエアフィルタ２７が設けられており、凝縮器６１により排出ガスから分離された空気はエアフィルタ２７を介して大気に放出されるようになっている。エアフィルタ２７は外部からの不純物が燃料電池システム内に侵入することを防ぐ。還水管５９、還水ポンプ６０及び凝縮器６１が補機５０である。

【００２８】また、水タンク５１と凝縮器６１との間には水素供給手段３０の水素貯蔵装置３１が位置している。水素貯蔵装置３１は外郭を構成するハウジング３２内に水素吸蔵合金が充填されたものである。また、高圧の水素タンクを水素貯蔵装置３１に用いることもできる。水素貯蔵装置３１のハウジング３２には内部を流路とする共通管４１が接続され、共通管４１には流路を開閉可能な元締め用開閉弁４２が設けられている。

【００２９】共通管４１の元締め用開閉弁４２より下流には、共通管４１の内部も含め、内部を水素ガス給気路とする水素供給管３３が接続されている。水素供給管３３は一次圧センサ３４、調圧弁３５、開閉弁３６及び二次圧センサ３７を介して燃料電池装置１０のハウジング１１の側方に接続され、図３に示すスタック１２の全水素ガス流路１３ｆの入り口側に連通している。

【００３０】また、図２に示すように、共通管４１の元締め用開閉弁４２より下流には水素充填口４３に接続さ

れる水素充填管４４が接続されている。水素充填管４４には排出管４５が接続され、排出管４５には異物排除用開閉弁４６が設けられている。これら排出管４５、異物排除用開閉弁４６、共通管４１及び元締め用開閉弁４２が異物排除装置である。

【００３１】さらに、燃料電池装置１０のハウジング１１の側方には、燃料電池装置１０の全水素ガス流路１３ｆの出口側と連通する水素排気管３８が接続されており、水素排気管３８には逆止弁３９を介して開閉弁４０が設けられている。これら水素貯蔵装置３１、水素供給管３３、調圧弁３５、開閉弁３６、水素排気管３８、逆止弁３９及び開閉弁４０並びに異物排除装置が水素供給手段３０である。

【００３２】また、エアフィルタ２２の上流側には外気温を検出するための外気温センサ７０が設けられ、排気マニホールド２５に近い位置には排出ガスの出口温度を検出するための排出温度センサ７１が設けられている。また、水タンク５１内には内部に貯溜している水の温度を検出するための水温センサ７２と、その水の水位を検出するための水位センサ７３とが設けられている。これら外気温センサ７０、排出温度センサ７１、水温センサ７２及び水位センサ７３の検出信号は、図１に示すように、制御部７に入力されるようになっている。

【００３３】上記開閉弁５５、大気開放弁５８、開閉弁３６、開閉弁４０、元締め用開閉弁４２及び異物排除用開閉弁４６は電磁弁で構成されている。また、これら開閉弁５５、大気開放弁５８、開閉弁３６、開閉弁４０、元締め用開閉弁４２及び異物排除用開閉弁４６並びに上記給水ポンプ５４、還水ポンプ６０、一次圧センサ３４、二次圧センサ３７、給気ファン２３、ヒータ２４及び冷却ファン６１ａも制御部７に電気的に接続されている。

【００３４】上記のように構成された燃料電池システム１では、制御部７の指令により、開閉弁５５、大気開放弁５８、開閉弁３６、開閉弁４０、元締め用開閉弁４２及び異物排除用開閉弁４６並びに上記給水ポンプ５４、還水ポンプ６０、給気ファン２３及び冷却ファン６１ａが駆動される。特に、氷点下等、外気温が低温である環境下においては、制御部７の指令によりヒータ２４が駆動される。

【００３５】これにより、エアフィルタ２２、給気ファン２３、ヒータ２４及び給気マニホールド２１を介して燃料電池装置１０に大気中の空気が供給される。こうして、スタック１２の全空気流路１３ｅに空気が供給される。

【００３６】一方、水素貯蔵装置３１内の水素ガスが水素供給管３３、調圧弁３５及び開閉弁３６を介して燃料電池装置１０に供給される。こうして、スタック１２の全水素ガス流路１３ｆに水素ガスが供給される。

【００３７】これにより、スタック１２の全水素極１３ｄと全空気極１３ｂとの間において電気化学反応を生じ、起電力が得られる。こうして得られた起電力はＤＣ／ＤＣコンバータ２により昇圧又は減圧され、バッテリ６及びインバータ４に印加される。これによりモータ５が駆動され、電気自動車が走行可能となる。

【００３８】そして、水素貯蔵装置３１内の水素の貯蔵量が減少してくれば、水素充填源をもつ水素スタンドに立ち寄り、水素充填口４３に水素充填源を連結する。この間、制御部７は、図５に示すフローチャートに従って制御を行う。まず、第１ステップＳ１０において、元締め用開閉弁４２を閉じる。この後、第２ステップＳ１１において、元締め用開閉弁４２が閉じられた状態で、水素充填口４３への水素充填源の連結を待つ。そして、第３ステップＳ１２において、水素充填口４３へ水素充填源が連結されれば、一定時間異物排除用開閉弁４６を開く。この後、第４ステップＳ１３において、一定時間経過後、異物排除用開閉弁４６を閉じる。そして、第５ステップＳ１４において、異物排除用開閉弁４６が閉じられた状態で、元締め用開閉弁４２を開ける。

【００３９】こうして、水素貯蔵装置３１と水素充填口４３とを接続する水素充填管４４を介し、水素貯蔵装置３１内に新たに水素を充填することがなされる。この際、空気等の異物を異物排除装置が確実に排除することができる。このため、この燃料電池システム１は、異常反応を生じず、安定した発電効率を発揮できる。

【００４０】すなわち、燃料電池装置１０において、水素極１３ｄの電解質に触媒が担持されていても、空気に含まれる酸素によって水素極１３ｄ内で局部的な電池が形成されることはなく、空気極１３ｂの電解質に担持されている触媒が劣化せず、安定した発電効率を発揮できる。また、水素貯蔵装置３１の水素吸蔵合金は酸化されずに高い水素貯蔵能力を維持し、やはり安定した発電効率を発揮できる。

【００４１】したがって、この燃料電池システム１及び方法によれば、安定した発電効率を発揮可能である。

【００４２】また、この燃料電池システム１及び方法では、水素充填管４３が水素供給管３３の一部である共通管４１を介して水素貯蔵装置３１に接続され、共通管３１に元締め用開閉弁４２が設けられているため、配管が簡素化され、製造コストの低廉化の効果がある。また、共通管４１に元締め用開閉弁４２が設けられているため、元締め用開閉弁４２を閉じることにより、異物が水素貯蔵装置３１に侵入することを確実に防止できるとともに、水素貯蔵装置３１の交換時に水素が漏れることを防止できる。

【００４３】なお、図６に示すように、水素供給管３３とは別に水素貯蔵装置３１に接続される水素充填管４７を設けることもできる。この場合、水素充填管４７に元締め用開閉弁４２、排出管４５及び異物排除用開閉弁４６を設けることが好ましい。

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【００４４】また、図７に示すように、水素充填管４４が共通管４１を介して水素貯蔵装置３１に接続されている場合、共通管４１、水素充填管４４及び水素供給管３３間に異物排除用開閉弁と元締め用開閉弁とを共通化する三方弁４８を設けることもできる。この場合、部品点数が削減され、燃料電池システムの製造コストの低廉化の効果がある。

【図面の簡単な説明】

【図１】実施形態に係る電気自動車のブロック構成図である。

【図２】実施形態に係る燃料電池システムの構成図である。

【図３】実施形態に係るスタックの一部斜視図である。

【図４】実施形態に係るセルの断面図である。

【図５】実施形態に係る制御部のフローチャートである。

【図６】変形形態に係る燃料電池システムの要部構成図である。

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【図７】変形形態に係る燃料電池システムの要部構成図である。

【符号の説明】

１３ｅ…空気流路

１３ｂ…空気極

１３ｆ…水素ガス流路

１３ｄ…水素極

１３ｃ…電解質層

１０…燃料電池装置

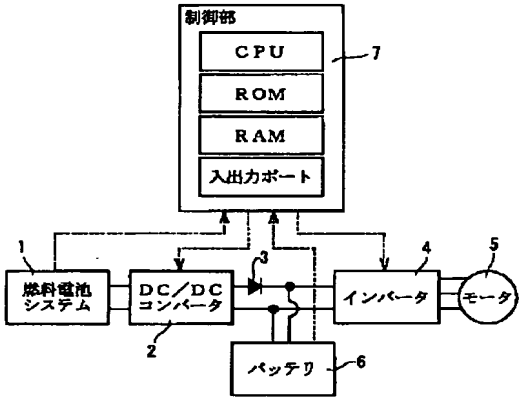
３０…水素供給手段

３１…水素貯蔵装置、３３…水素供給管、４３…水素充填口、４４…水素充填管、４５、４６、４１、４２…異物排除装置（４５…排出管、４６…異物排除用開閉弁、４１…共通管、４２…元締め用開閉弁）

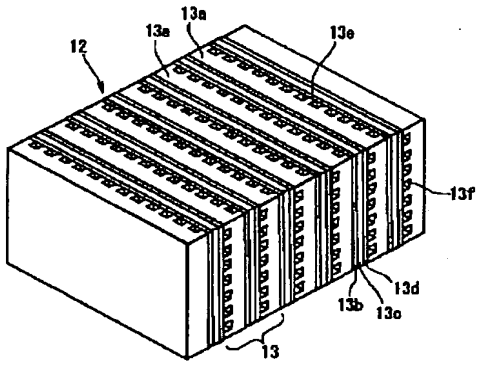
１…燃料電池システム

７…制御部

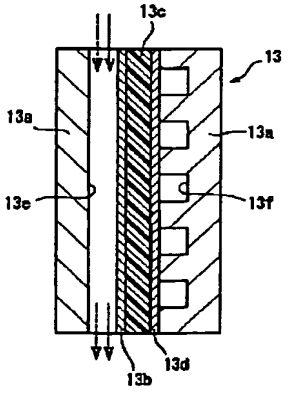
【図１】



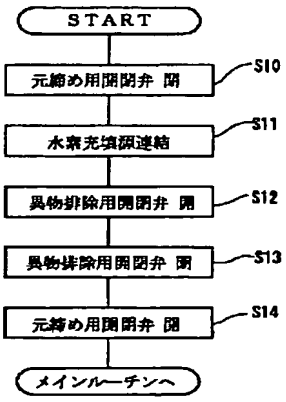
【図３】



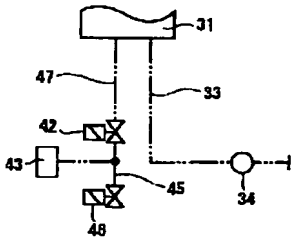
【図４】



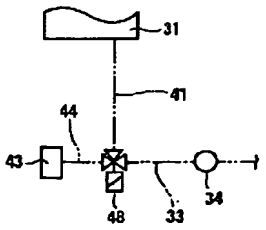
【図５】



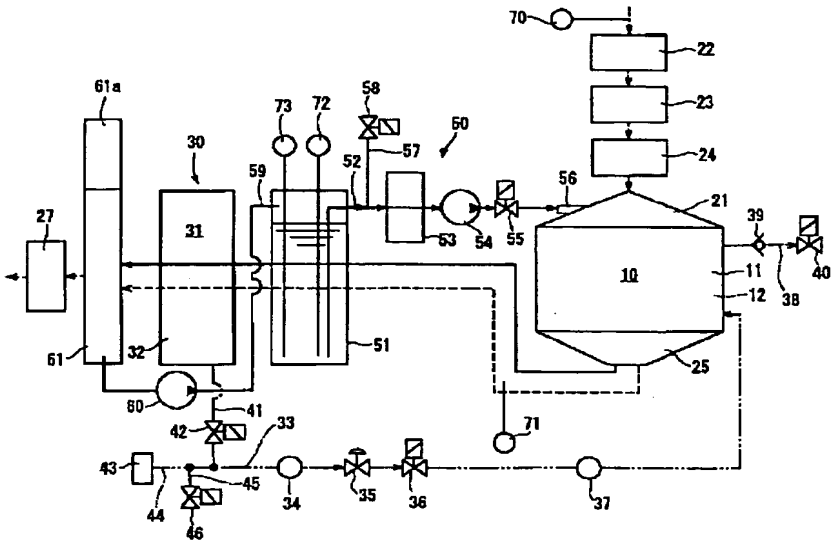
【図６】



【図７】



【図２】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